**U.S. Army Research Institute
for the Behavioral and Social Sciences**

Research Report 1729

Battle Staff Training System II: Computer-Based Instruction Supporting the Force XXI Training Program

Richard L. Wampler and Stephen C. Livingston
BDM International, Inc.

November 1998

19990126 112

[DTIC QUALITY INSPECTED 8]

U.S. Army Research Institute
for the Behavioral and Social Sciences

A Directorate of the U.S. Total Army Personnel Command

EDGAR M. JOHNSON
Director

Research accomplished under contract
for the Department of the Army

BDM International, Inc.

Technical review by

Margaret S. Salter
Andrew S. LaJoie

NOTICES

REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy) November 1998	2. REPORT TYPE Final	3. DATES COVERED (from. . . to) June 1997 – June 1998	
4. TITLE AND SUBTITLE Battle Staff Training System II: Computer-Based Instruction Supporting the Force XXI Training Program		5a. CONTRACT OR GRANT NUMBER MDA 903-92-D-0075 DO 53	
		5b. PROGRAM ELEMENT NUMBER 0602785A	
6. AUTHOR(S) Richard L. Wampler and Stephen C. Livingston		5c. PROJECT NUMBER A791	
		5d. TASK NUMBER 2228	
		5e. WORK UNIT NUMBER R04	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) BDM International, Inc. 6001 Indian School Road Albuquerque, NM 87110		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research Institute for the Behavioral and Social Sciences ATTN: TAPC-ARI-IK 5001 Eisenhower Avenue Alexandria, VA 22333-5600		10. MONITOR ACRONYM ARI	
		11. MONITOR REPORT NUMBER Research Report 1729	

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

COR: Kathleen A. Quinkert

14. ABSTRACT *(Maximum 200 words)*:

This report documents the methodology and lessons learned in the development of the Innovative Tools and Techniques for Brigade and Below Staff Training II - Battle Staff Training System II (ITTBBST-BSTS II). This effort supported the Army's distance learning initiative by developing three computer-based training (CBT) courses of instruction on CD-ROM. An existing Brigade Common Core training support package (TSP) was converted from a text and computer-based TSP to a 100% CBT course with limited adjunctive text materials. In addition, TSPs were developed for the Training Developer and CBT Author to train them to update and maintain an existing library of courses. These TSPs were also 100% CBT. The ITTBBST-BSTS II Brigade Common Core course can replace the similar course in the existing BSTS library of courses for use by the Total Force. The Training Developer and CBT Author courses are designed for use at an institution with responsibility for updating and maintaining BSTS courseware. The Brigade Common Core and Training Developer courses are designed for use in a local area network, wide area network, or stand-alone computer mode. The CBT Author course is designed for stand-alone use only.

15. SUBJECT TERMS

Battle Staff Skills   Staff Training   Computer-Based Instruction   IconAuthor™   ToolBook™   Train-the-Trainer

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON (Name and Telephone Number) Kathleen A. Quinkert (502) 624-2613/3450
16. REPORT Unclassified	17. ABSTRACT Unclassified	18. THIS PAGE Unclassified	Unlimited	30	

Standard Form 298

Battle Staff Training System II: Computer-Based Instruction Supporting the Force XXI Training Program

Richard L. Wampler and Stephen C. Livingston
BDM International, Inc.

Armored Forces Research Unit
Barbara A. Black, Chief

FOREWORD

This report documents the methodology and lessons learned in the development of the Innovative Tools and Techniques for Brigade and Below Staff Training II - Battle Staff Training System II (ITTBBST-BSTS II). The ITTBBST-BSTS II project was developed as part of the U.S. Army Research Institute for the Behavioral and Social Sciences' ongoing research for the Force XXI Training Program to establish innovative methodologies for training combined arms forces. The Armored Forces Research Unit has conducted previous research to develop text and computer-based courses of instruction to train commanders and staffs in their fundamental combat skills using scenario-based training support packages (TSPs). This project was initiated to eliminate the requirement for text-based materials in training staff officers.

The ITTBBST-BSTS II research effort built on the library of TSPs that train selected staff officers and commanders in current Army battlefield doctrine, allowing them to practice using that doctrine. One component of the project converted the existing Brigade Common Core course from a text and computer-based TSP to a 100% computer-based training (CBT) course of instruction. The second component developed the means to train government personnel in the process of updating and maintaining the existing library of BSTS courseware.

Results of this research have been provided to the Directorate of Training and Doctrine Development's Force XXI Training Program at the US Army Armor Center and serve as an excellent model for future efforts to develop and implement individual computer-based instructional courseware.

ZITA M. SIMUTIS
Technical Director

BATTLE STAFF TRAINING SYSTEM II: COMPUTER-BASED INSTRUCTION SUPPORTING THE FORCE XXI TRAINING PROGRAM

EXECUTIVE SUMMARY

Research Requirement:

Army commanders and staffs need structured training support packages (TSPs) for training and assessment of individual combat skills. The existing Battle Staff Training System (BSTS), a combination of text-based and computer-based lessons, provides 28 TSPs for this purpose. The advent and expansion of computer-based training (CBT) will result in less text-based training material. In addition to developing expanded CBT TSPs for commanders and staffs, training developers and CBT authors must know how to maintain the currency of CBT TSPs. The purpose of this research effort was to convert one of the existing BSTS courses to 100% CBT (excluding job aids) as well as to design and develop CBT courses to prepare training developers and CBT authors to update and maintain the existing TSPs.

Procedure:

Innovative Tools and Techniques for Brigade and Below Staff Training II - Battle Staff Training System II (ITTBBST-BSTS II) was developed through the use of the Systems Approach to Training (SAT) process as applied to the design and development of interactive multimedia courseware.

The target audience for each course was analyzed in light of the tasks required of the incumbent in the performance of his or her duties. The analysis for converting the Brigade Common Core course included a review of previous BSTS job analyses, review of applicable doctrinal publications, review of lessons learned available from published material or military subject matter experts (SMEs), and review and approval by the customer. The review for the Training Developer and CBT Author courses required a bottoms-up approach to identify the required performance measures since these were new courses and were not based on any established military procedures. This analysis was conducted by the contractor experts who produced the BSTS courseware.

The design process used the results of the job analyses to determine tasks, identify which of these tasks were critical, produce instructional objectives, develop criteria test items, prepare course maps, develop course strategies, and prepare examinations. Formative evaluation was initiated early in the design phase, and continued throughout development. Development of course material was based on the analysis and design completed by the research team. The prototype courses were implemented on a trial basis through SME and target audience testing at Fort Knox, Kentucky, and Fort Benning, Georgia. Results of testing were used to revise each TSP.

Findings:

While the sample size was relatively small, results from this research effort provide positive support for CBT. The time to complete the Brigade Common Core course was reduced, on the average, by 40% and the end of course comprehensive exam scores increased. These results are consistent with other research projects on the benefit of CBT. Since the Training Developer and CBT Author courses were new, there is no before and after comparison available. However, participant feedback and performance results indicate that these courses will be extremely effective in preparing U.S. Army Training and Doctrine Command (TRADOC) school personnel to review and modify the library of BSTS courseware.

Utilization of Findings:

The 100% Brigade Common Core course developed in ITTBBST-BSTS II has shown itself to be effective in improving staff officer skills and knowledge in individual tasks. Previously, training developers and CBT authors had no materials available to train them in how to update and maintain existing BSTS courseware. The Training Developer and CBT Author courses developed in this project are critical to filling this void. Also, the CBT method of instruction received high value ratings from target audience participants and would appear to lend itself to further development and expansion as a method of individual training. These products add to the library of individual training tools available to support combat units and TRADOC schools. The training developer/author courses enable TRADOC to update and expand the library. The lessons learned will help future development teams design and develop new CBT courses for individual training.

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Introduction

In support of the Force XXI Training Program (FXXITP), the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) has conducted research on various training strategies for preparing individuals and staff groups at battalion and brigade level to perform their combat tasks. The Infantry Forces Research Unit (IFRU) at Fort Benning, Georgia, began with an effort to identify critical combat skills required of commanders and staffs based on weaknesses in unit performance at the Combat Training Centers. This evolved into the development of selected text and computer-based training (CBT) training support packages (TSPs) for staff officers at battalion and brigade level (André & Salter, 1996a, 1996b). The Armored Forces Research Unit (AFRU) at Fort Knox, Kentucky, expanded this effort by developing CBT courses for commanders, revising the existing staff officer TSPs to include updated doctrine, and adding comprehensive end of course evaluation components (COMPS) to all courses based on standard scenarios used in other training programs (André, Wampler & Olney, 1997). Also, in two related projects, the IFRU pursued the development of 100% CBT courses to fill current training requirements (Wampler, Centric & Salter, 1998a, 1998b).

Throughout the above efforts, the AFRU has worked closely with the FXXITP, an initiative designed to carry the Army's training capabilities into the 21st Century (U.S. Army Training and Doctrine Command [TRADOC], 1994). The effort began with several research projects. One of those was the Innovative Tools and Techniques for Brigade and Below Staff Training (ITTBBST) program. The ITTBBST program consisted of three interrelated efforts. One component was analyzing Battlefield Functions which established the common basis for designing individual and staff training programs (Ford, Mullen & Keesling, 1997). Next was the development of the Battle Staff Training System (BSTS) courses to train individual commanders and staff members on planning and preparing for combat (André et al., 1997). The final component of this program developed the Staff Group Trainer, an innovative tool for training small groups of staff officers. This component provides a training link between the individual staff training courses in BSTS and collective training exercises involving the integrated staff (Koger et al., 1998).

The ITTBBST-BSTS II program is built on the lessons learned from ITTBBST-BSTS (André et al., 1997). Previous research indicated that the BSTS courseware improved staff officer skills and performance as evidenced by an average of more than 20% improvement between pretest and posttest results. Also, test participant results indicated that CBT was a preferred form of instruction over reading text-based lessons and doctrinal reference manuals. Additionally, there was a recognized requirement to update and maintain the BSTS instructional material based on evolving doctrine. Individuals would need to be trained to review and modify the existing text and computer-based courseware to incorporate necessary changes.

Background

As discussed by André et al. (1997), the U.S. Army is exploring and implementing various distance learning techniques to meet the challenge of complex, highly diverse training requirements with increasingly constrained resources. Given the tenets of the Army Distance Learning Plan (Department of the Army [DA], 1996), TRADOC has set a course to implement distance learning as the preferred method of instruction now and in the future. Training research conducted by both the AFRU and IFRU of ARI has resulted in a library of text and computer-based TSPs that can be used for distance learning at schools, in units, or in a stand-alone mode by staff officers.

Unfortunately, full implementation of a distance learning train-the-trainer program for government training developers and CBT authors will not occur, based on the current schedule, until early 2000 (DA, 1996). Government training developers must develop their skills from on-the-job training and may not be knowledgeable of how to review and update CBT courses. In addition, CBT authors will need to attend commercial courses of instruction to learn appropriate programming skills, but still will not have the necessary information to update and maintain existing CBT courseware. Training for these CBT authors requires associated course registration fees and travel costs.

Results from previous research with target audience staff officers indicate that CBT is a preferred means of presenting training (André et al., 1997). As indicated above, the BSTS products developed for the FXXITP are a combination of text and CBT materials. With an expanding availability of computers for staff officers and increased access to the Internet, an alternative to printed instructional material could be beneficial. One possibility is 100% CBT courseware.

Fletcher (1995) summarized research efforts addressing CBT applications in military training. He found reports of reductions in training time as well as positive student attitudes for computer managed instruction. Still other reports address better test performance from using computerized training aids as contrasted with text-based workbooks. Fletcher also found reports of reduced training costs (Fletcher, 1995). More details contained in Fletcher's summary are available in André et al. (1997).

Olmstead (1992) stated that:

Evidence has been mounting to support the concept that maximum effectiveness can be achieved only when a battle staff directly addresses the quality of its organizational functioning and develops capabilities that enable it to maintain functional integrity under the stress of battlefield pressures. (p. II-10)

He continues, stating successful performance of these battle staff functions is dependent, in part at least, on two skill sets. Battle staff members must be proficient in their individual role specific

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skills, as well as the team performance skills that are needed for the collective execution of team processes (Olmstead, 1992). The BSTS II program builds on Olmstead's research by developing a 100% CBT individual battle staff training course to enhance the performance of organizational processes by providing training for the individual, thereby enhancing the performance of the organization.

Peters (1997) states:

Government agencies are increasingly turning to distance learning as an affordable means

of keeping employees trained and informed in the ever-changing federal workforce....

Affordable, flexible training for large numbers of workers has become critical as agencies

cope with tremendous organizational and technological changes brought on by

downsizing and implementation of governmental reforms. (p. 31)

The increasing development of CBT courses mandates that government training developers and CBT authors be trained in updating and maintaining this newly evolving courseware.

Bloom (1984) suggests that students taught one-on-one by an individual instructor can demonstrate greater achievements than those taught in a classroom group of 30. The North Atlantic Treaty Organization Research Study Group 16 states that instructional efficiency can be gained when the training is tailored to the needs of the student. This efficiency is becoming a necessity as military training budgets diminish. However, providing an instructor to each student is not economically feasible. The study group concluded that CBT provided an economic solution by substituting the cost of CBT development for the requirement to provide human instructors (Fletcher, 1995).

The value of CBT to military trainers is significant. The BSTS II program applies the outcome of references cited above in providing three TSPs that can enable one-on-one instruction in a resource effective manner for both military and civilian training. In addition, since CBT is essentially a self-paced and independent study vehicle, it reduces the scheduling/conflict resolution requirements inherent in classroom and learning center training. Also, costs and time lost in instructor and student travel are reduced or negated, depending on the method of CBT employed.

Statement of the Problem

There is currently no training program or course that instructs the government training developer how to review and update the BSTS courseware. A training program is necessary to provide the capability to modify the courses as doctrine changes. Also, previous research indicates that CBT reduces the required training time for students. While the library of staff officer training courses in BSTS is valuable, with the limited training time available to staff officers, courses could possibly be more beneficial if the instructional materials were produced as 100% CBT. Before expending limited resources to convert all BSTS courseware, research should be conducted to determine the value of 100% CBT courseware.

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Previous research conducted by ARI (André et al., 1997) served as the foundation for this program. Lessons learned from that program were the starting point for this effort. In addition, two revised doctrinal publications were used in updating the Brigade Common Core course: Field Manual (FM) 101-5, Staff Organization and Operations (DA, 1997b), and FM 101-5-1, Operational Terms and Symbols (DA, 1997a).

The BSTS II program consisted of three TSPs that, based on previous lessons learned, were developed as 100% CBT. All instructional material is contained in a computer-based format. There is limited adjunctive text-based material.

One training package was a conversion of the existing text and computer-based Brigade Common Core TSP into a 100% CBT course. The course was designed to train common individual staff officer skills required to plan and prepare for combat. This conversion also included updates to bring the course in line with current doctrine. This revised course was developed as a potential replacement for the existing BSTS TSP. It is for use by the total force, Active and Reserve, and can be used in a local area network (LAN), wide area network, or stand-alone computer mode.

The second training package, the Training Developer course, was designed to train a government subject matter expert (SME) how to review existing BSTS courseware, including both text and CBT material. The Training Developer course explains how to update and revise the text-based lessons and provides a process to convey needed computer-based material changes to a CBT author. This course was designed for use in a TRADOC school or similar institution charged with responsibility for updating and maintaining BSTS courseware. Like the existing BSTS TSPs, the Training Developer course can operate in any computer mode.

The third TSP, the CBT Author course, trains CBT authors in the skills and knowledge required to incorporate changes into the computer-based portions of the TSPs developed under the ITTBBST-BSTS research program, based on the revisions identified by the training developer. Like the Training Developer course, the CBT Author course was designed for use in a TRADOC school or similar institution charged with responsibility for updating and maintaining BSTS courseware. The course was designed only to operate in a stand-alone computer mode.

Technical Objectives

The BSTS II program was designed to address the following technical objectives:

1. To convert an existing BSTS course to 100% CBT and formatively evaluate the prototype course.

2. To design, develop and formatively evaluate two new 100% CBT courses; one for government training developers and one for CBT authors. These courses were designed to train personnel how to update and maintain BSTS courseware.

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Method

Project Overview

The two technical objectives established the requirements for this project. First, there was a need to establish a 100% CBT course for staff officers and test its acceptability. Second, there was a requirement to develop a means to train government training developers and CBT authors to update and maintain the existing BSTS library. The BSTS II project, using the Systems Approach to Training (SAT), applied the same process as was used in BSTS (André et al., 1997).

Analyze

The initial step was to determine the specific tasks to be trained in each of the courses. A front end analysis was conducted along with a determination of the intended target population. The other key part of this step was to identify the appropriate references to be used in developing the course content.

Since the Brigade Common Core course already existed, this was a relatively straight forward process. A task analysis determined that no changes were needed to the tasks to be trained and the target audience remained unchanged. A doctrinal publication review found that two publications had been updated since the BSTS course was developed. These manuals (FM 101-5 and FM 101-5-1) served as the foundation for about half of the course material. The military decision-making process (MDMP) documented in FM 101-5 (DA, 1997b) was changed from a situational dependent, three-model concept, to a single model for all situations. An entire subject on the MDMP in the existing BSTS course was outdated based on the latest FM 101-5. In addition, a revised FM 101-5-1 (DA, 1997a) presented several changes to doctrinal terms, definitions, and graphic symbols. This meant a lesson on military graphics and symbols was outdated. Additionally, military graphics and terminology within all of the course material had to be reviewed to ascertain if changes were required. To ensure that the doctrinal material in the Brigade Common Core course was doctrinally correct, the latest doctrinal material was included, despite the fact that this course would now be inconsistent with other BSTS courses.

Since the Training Developer and CBT Author courses were new, the target audience needed to be defined. The ARI personnel assisted in identifying the anticipated skills of the military and civilian personnel who would be tasked to update and maintain the BSTS courses. The only existing reference for reviewing and updating the BSTS courseware were the procedures developed and used by the contractor. A review of these procedures along with interviews of training developers and CBT authors who were involved in the development of BSTS resulted in identification of the critical tasks to be included in the courses.

The resulting job analysis led to the conclusion that the Training Developer course should train the student not only to review the text and CBT material, but also to make necessary changes to text-based lessons. The results from this phase of the SAT process led to the next step, design.

Design

Park and Hannafin (1993) found that the development of interactive multimedia is based more on technological capacity than research and theory. They concluded that "the guidelines for multimedia design are based not on empirical evidence, but on the intuitive beliefs of designers" (1993, p. 63). They proposed a framework for organizing research and theory related to interactive multimedia design that includes psychological, pedagogical, and technological foundations. The design of BSTS II employs some guidelines suggested by Park and Hannafin, namely the concepts of prior knowledge, symbol systems, feedback in CBT, instructional control in CBT, and the capability of interactive multimedia.

Additional research suggests leaving the pace of the lesson under the control of the user, avoiding the placement of too much text on a screen display, and providing the learner with instructions on what to do next (Gagné, Wagner & Rojas, 1981). These suggestions have been incorporated into the BSTS II TSPs. The BSTS II research applied the instructional prescriptions for learner control as proposed by Chung and Reigeluth (1992):

> There has been a great deal of research in the area of learner control, which is widely
>
> believed to be a highly desirable feature of individualized and interactive learning
>
> systems because, it is said, this enables learning to be individualized to each person's
>
> needs. Unfortunately, research findings regarding the effects of learner control have been
>
> inconclusive, and, what is more, they have been more frequently negative than positive.
>
> (p. 14)

The researchers propose an integration of learner control methods (content control, sequence control, pace control, display control, internal processing control, and advisement strategy) into a form useful to the design of instruction. The TSPs developed in BSTS II applied content control, sequence control, and pace control.

The design process used for BSTS II was identical to the process for BSTS (André et al., 1997). The critical task lists and draft course maps for each course were reviewed by ARI and members of the FXXITP team prior to course development. Tutorials, practical exercises, media selection, and assessment components (tests) were designed into the courses following the criteria used in designing the original BSTS courses.

There were two major differences in the testing design. First, a COMPS component was not included for the Training Developer and CBT Author courses. The BSTS COMPS were based on operational scenarios and were intended to have staff officers apply newly learned skills to combat situations. This requirement was not appropriate for the training developer/CBT author. Second, there were no subject pretests for the CBT Author course. It was determined that students completing this course would not be familiar with the design structure for the BSTS courseware and, therefore, there was no need to assess prior knowledge.

Even though the design process was the same, there is one significant point worth discussing in this area. The designs for these three courses originally indicated that all material would be produced in CBT; there would be no text-based material. The plan was to include navigation and operating instructions at the beginning of each course in CBT format. Following the initial design of the courses, ARI determined that certain adjunctive material would be useful in a text-based workbook for student reference. While all instructional material for each course was to be CBT, a student workbook would include: an introduction to the course with operating and navigation instructions, a course map, job aids, and a reference list for various help sources.

Formative evaluation (FE) was initiated early in the design phase, and continued throughout the development of the courses. The FE procedures are discussed later in this report.

Develop

While the BSTS II development process was similar to the BSTS process, there were a number of differences. These differences resulted from two main factors. Lessons learned from other CBT development projects identified some improved techniques that were implemented. Also, the large volume of CBT in each course as well as the requirement to have multiple software programs operating simultaneously during a course caused a variety of programming changes.

Authoring into CBT for the Brigade Common Core and Training Developer courses was accomplished using IconAuthor™ software, assuring compatibility with all BSTS program courseware. The courses were also developed to operate within the training management system (TMS) used for the BSTS courseware.

Programming the Brigade Common Core course presented a challenge in linking two compact discs (CDs) which contained instructional material for the same subject (Subject 4, The Military Decision-Making Process). This problem was not encountered in previous BSTS courseware. Risks were analyzed, and it was determined that many files would need to be duplicated on both CDs. These files essentially were all TMS linked files - subject menu files, as well as subject and lesson tests. The objective was to make all transitions transparent to the student. This meant that the student would only be required to change CDs at an on-screen prompt. Also, he or she could move back and forth between CDs. Finally, the changed CD methodology would work within the TMS to preclude any fatal errors while ensuring the student received credit for reviewing the courseware and any tests taken.

The solution to this problem required that menu items be repeated on both CDs. The message to change CDs was placed between the menu selection and the actual structure that called the lesson. Once the message was acknowledged by the student (who was required to replace the CD, let it "spin up," and then click "OK") the program, which is linear, proceeded to call the next lesson. Both CDs were structured in this manner, which allowed free movement between CDs, in either direction.

Developing the Training Developer course incorporated techniques to improve skill retention and allow the quickest possible access to major topic areas of instruction. For example, even though the student is not familiar with BSTS courseware development, a pretest is provided at the start of each subject. This alerts the student to the type of material to be presented in the course. Quizzes were included following most major topics to help reinforce the instructional material. Numerous samples for developing text-based material were taken from the course development procedures and included in the CBT as well as the student workbook. A variety of "screen captures" from various program software packages and BSTS courses were built into the courseware so the student could experience actually reviewing CBT material. A variety of review methods were presented so the student had flexibility in reviewing CBT material, depending on the type and amount of material that needed to be reviewed. Finally, the courseware was structured in a modular fashion so a person desiring to review a single training developer skill could quickly and easily access the desired topic.

The CBT Author course was developed for personnel who had attended a minimum of the IconAuthor™ Basic course, and preferably the advanced course. This would preclude having to teach IconAuthor™, and allow the course to focus on BSTS-specific programming conventions. This was critical to ensure that any future modifications to BSTS courses did not destroy links to the TMS and that course conventions (checkmarks, bookmarks, testing, and menus) were understood. The course was intended to instruct the student on what information was contained in which files, and how to quickly locate page or structure problems. The problem initially was to determine the best method of delivery.

The desired design of the CBT Author course was to "coach" the student through some of the more difficult programming concepts, such as navigational loops and branching, while actually in the authoring program. This required the computer-based lesson to run at the same time the authoring program was open. However, IconAuthor™ does not allow the runtime player (Present) and the authoring software to run simultaneously. It was necessary to find a program that would allow the IconAuthor™ authoring program to run while the presentation (coach) program could operate in its own runtime player. Initial experiments by the CBT team indicated that ToolBook II™ would run while IconAuthor™ was open. In some of the more difficult lessons a ToolBook II™ sidebar as shown in Figure 1 was added to the screen that ran a menu and a means to repeat audio. Next to the sidebar ran IconAuthor™ in the authoring mode. The lesson literally coached the student through activities, using the IconAuthor™ screen mapping system to locate structure and icons.
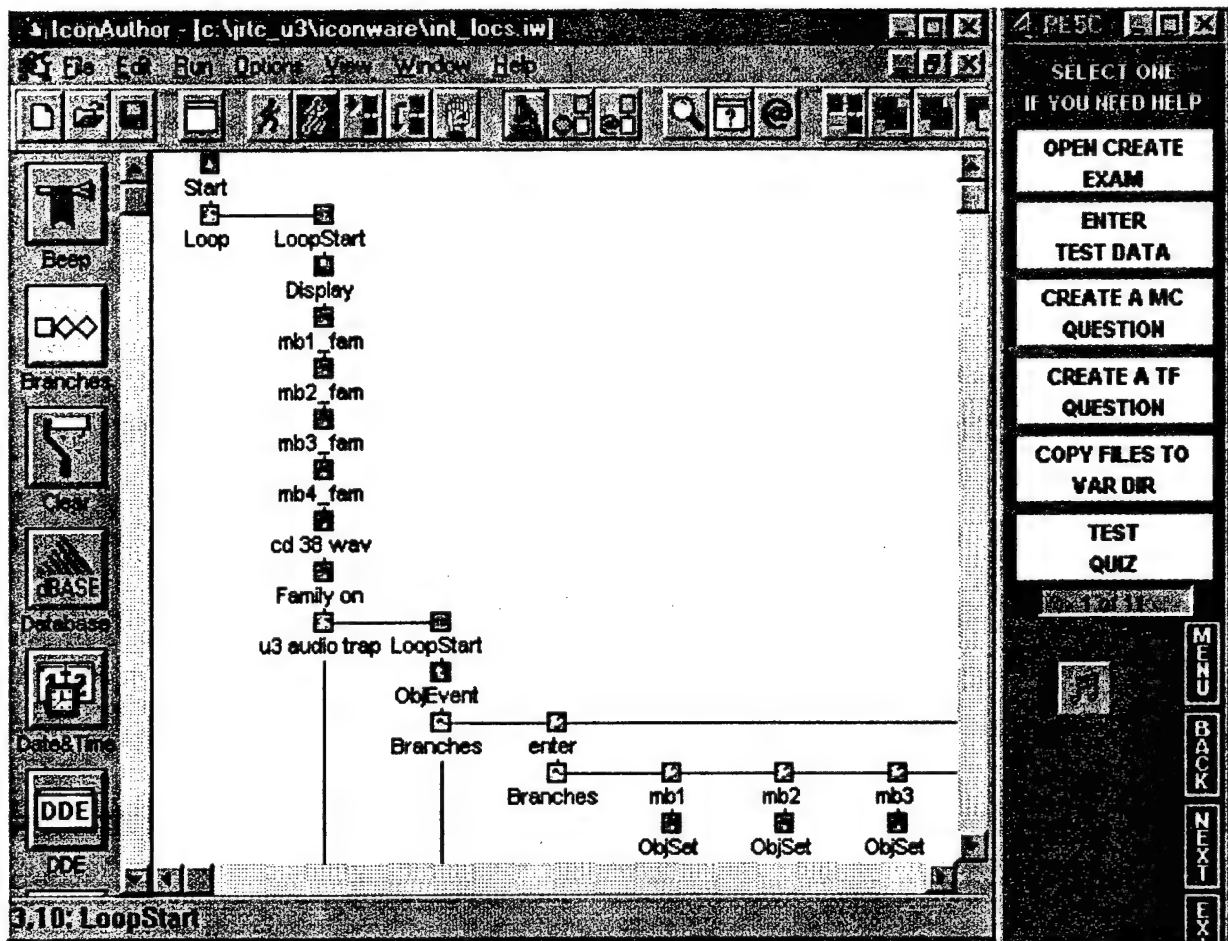
Figure 1. A representation of a ToolBook II™ sidebar with IconAuthor™ in the authoring mode.

Another difference in the CBT Author course involved the use of Lotus ScreenCam™ to show the student how something was done, in many cases including narration. This would make it easier for the student to understand, and it would allow the use of the "teach/show/do" method of training. ScreenCams™ were to be used in two methods: one where simple tasks are shown, and another where students are shown how to do a complex task and then are required to perform the same task. Students could call on an audio coach to assist them. A number of problems were encountered while using ScreenCam™.

The person recording the ScreenCam™ needed to be the SME for the material, not an audio/video specialist. It was too difficult and cost prohibitive to attempt this with the SME explaining to the audio/visual person what to do and how to do it, and still ensure that the narration and video were synchronized. Even though someone produced the narration other than a professional narrator, the result was well received by beta test personnel, who felt that the instruction was informal, friendly, and easy to understand.

The second problem encountered was the speed of playback and the synchronization of audio with the ScreenCam™. While both are recorded simultaneously through ScreenCam™,

playback synchronization would sometimes be lost and either audio or video would get ahead of the other. Playback speed also seemed to be a problem, in that it appeared faster than what was originally recorded. This caused recordings to be done much slower and with extreme deliberation to create the proper effect on playback.

Another problem was an error message created by ScreenCam™ that stated it could not be played. However, after clicking "OK" in the error message box, the ScreenCam™ played normally. Information obtained from Lotus indicated that the current version of ScreenCam™ sometimes has conflicts with Windows 95 drivers, causing the message to appear. Clicking "OK" would allow ScreenCam™ to play normally. The problem was a software bug that would be fixed in future versions. Since the value of being able to show a student how to do something outweighed the annoyance of the error message, it was decided to keep the ScreenCam™ shots and instruct the students what to do when or if they encountered the error message.

The next problem was the selection of the file format to use with ScreenCam™. There were three choices, AVI Video for Windows format, SCN ScreenCam™ file format, and conversion to an executable file. We quickly found that AVI file formats were extremely large (many as large as 30 megabytes) so this option was discarded. Use of SCN ScreenCam™ files requires the use of the Lotus ScreenCam™ player. This would require the student to install one more program to his computer, so this choice was eliminated. Converting the ScreenCam™ files to an executable format proved to be the best choice. We then discovered that ToolBook II™ required that executable files be placed in the same directory every time. In order to make the solution seamless to the student, the install set that copied the ToolBook II™ runtime player to the student's computer also copied the ScreenCam™ files to the same drive. When the student uninstalled the program, the installation set would also remove the ScreenCam™ file directory.

The CBT Author course required multiple CDs, just as the Brigade Common Core course. We initially tried the same concept used for the Brigade Common Core, using dual menus to drive the CD change process. This did not work due to the fact that ToolBook II™ Instructor operates using an entirely different paradigm from IconAuthor™. It became necessary to create two install sets, one for each CD. The install sets created a program folder and menu selection items from the Windows start menu for CD1 and CD2. The menu selections indicated to the student which subjects were on which CDs, as did the actual course map, which was the master menu for the program.

Testing was also accomplished differently with the CBT Author course from other BSTS courseware. Due to the fact that the BSTS TMS and ToolBook II™ are not compatible, scores could not be recorded, but the student was shown his score at the end of each test. A "login" procedure was developed along with a method to record scores to a floppy disk in ASCII text format that allowed a mentor or supervisor to read student test question responses and the overall score for each test. Instructions in "how to" read these floppy disks were included in the printed "How To" portion of the course.

IconAuthor™ and ToolBook II™ are commercially available software programs; therefore, the source code of BSTS II courseware is not retained by the contractor, but can be opened by anyone that possesses a copy of IconAuthor™ and ToolBook II™.

Implement

Due to the nature of the BSTS II project, implementation and evaluation were closely interrelated and overlapped.

The Brigade Common Core and Training Developer courses were implemented on a trial basis at the Mounted Battle Space Battle Lab Test Bed, Fort Knox, Kentucky. The CBT Author course was implemented in the developmental facilities at Fort Benning, Georgia. Participants (SMEs) and target population personnel were selected, briefed and then issued prototype versions of the material a student would receive when taking a BSTS II course. These participants provided feedback and demographic data which was returned to course developers for evaluation. Appendix B provides a description of the participant requirements for this program.

Evaluate

The BSTS II FE followed the same basic method used in the predecessor BSTS program, with the addition of a Phase 0. Developers performed quality control checks on the course material throughout the design and development process. Additionally, test participants, including doctrinal SMEs and training developer experts as well as target population personnel, evaluated the materials at various phases of development. The five-phase process for this program is summarized below. See André et al. (1997) for a more detailed explanation of the process.

Phase 0 – Before any programming was accomplished, a full review of draft storyboards, both paper-based and electronic PowerPoint slides was conducted, to validate content and displays. This allowed the developer to modify the storyboards before a CBT author began programming.

Phase I - Alpha testing by contractor personnel to ensure proper functionality of all courseware.

Phase II - Alpha testing of the complete (draft) TSP by government SMEs at Fort Knox. This included at least one participant per course. Since no SME was available for the CBT Author course, this course was tested at Fort Benning by a contractor expert, under the supervision of two government representatives.

Phase III - Beta testing of the complete (draft) TSP by target population personnel at Fort Knox. This included two to five participants for each course. Most participants had completed an assignment as a battalion or brigade staff officer, were captains or Department of the Army Civilians, and were branch qualified for schooling. The CBT Author course was again tested by contractor personnel at Fort Benning under the supervision of government representatives.

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Phase IV – Review of the final (draft) TSP by ARI and designated team members. This included at least one participant for each course.

Procedures. The FE exercises were conducted on government provided hardware compatible with hardware and software of previous BSTS courseware. The 100% CBT Brigade Common Core and Training Developer courses were integrated into the BSTS TMS and placed on the LAN in the Mounted Battle Space Battle Lab Test Bed at Fort Knox. The CBT Author course was not compatible with the TMS so it was evaluated on a stand-alone computer at Fort Benning. All FE participants were coordinated and selected by the contracting officer's representative (COR). Analysis of FE results served as the basis for revising TSPs.

The FE of the BSTS II courses included evaluation of all courseware (CBT and student workbook) and the software providing the operating environment for the computer-based courseware. There were a few differences in FE procedures for BSTS II from the FE conducted for the BSTS program. These differences are discussed below.

As outlined above, there were five phases in this FE process. Phases I-IV were basically the same as in the BSTS program from the standpoint of objectives and implementation procedures. A new Phase 0 was conducted early in the development process. The COR and a team of government representatives reviewed the draft storyboards for all three courses. Paper-based storyboards were provided to the reviewers and comments were recorded directly on the storyboards. Also, electronic copies of the storyboards were available in PowerPoint so the actual layout and color of intended visual displays could be seen. A total of six reviewers over three days examined the technical content of the draft storyboards and provided suggestions for modifying the material. While this additional review step required more government participation, it actually conserved resources over the course of the program. Comments, changes, and corrections noted during this review were incorporated into the courseware before programming was accomplished. Therefore, participants in Phase II FE encountered fewer problems and made considerably fewer comments. This also meant revisions to the courseware following FE could be accomplished more quickly.

Prior to the start of each external FE step, participants were briefed on the BSTS II program as well as the conduct of the evaluation. At least one BSTS II team member was present during each external evaluation to observe, to record observations, and to assist participants with hardware and software issues. To measure the effectiveness of the courseware, FE data collection forms were prepared by the BSTS II team and approved by ARI. Forms were very similar to those used in BSTS data collection.

Having a development team member present during external evaluations was a specific recommendation from the BSTS program which was implemented for BSTS II. There were two major benefits to this approach. First, there were occasions when participants encountered a minor problem or had a question about the courseware. A knowledgeable development team member could answer these questions and resolve most issues on the spot. This saved time for the participant and also provided first hand information to the development team which expedited the revision process. The second benefit involved understanding participant

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comments. There were instances in the BSTS program where the development team members had difficulty understanding and accurately interpreting a participant's written comment when the FE forms were returned. During BSTS II the on-site development team member could easily clarify participant comments, ensuring that problem areas were clearly understood.

Government support requirements for FE activities were minimal due to the limited number of TSPs developed. Only 14 personnel from Fort Knox participated in Phases II-IV. This led to the final substantive difference between BSTS and BSTS II. Due to the technical nature of the CBT Author course, the contractor provided the qualified participant for Phase II and III FE. This FE occurred on a stand-alone computer at Fort Benning. All FE procedures used for the other courses, from briefing the participant to having the participant actually record comments on FE forms, remained the same.

Revision of training products. The results of FE Phases II, III, and IV were summarized and the TSPs were revised as appropriate. It is worth noting the Phase 0 FE resolved most of the technical content and layout issues so there were fewer participant comments in the later FE phases (compared to FE results in the BSTS program).

Results

The output of this program was three TSPs with all instructional material contained in CBT. The Brigade Common Core course is organized into four subjects that present the principles of Army operations doctrine, the fundamentals for employing an armored or mechanized infantry brigade, the key staff functions that are necessary to achieve staff integration, and the decision-making process as contained in FM 101-5 (DA, 1997b). All instructional material is contained on five CDs. An introduction to the course, a course outline, and selected job aids are contained in a loose-leaf notebook. The end of course COMPS are provided on a separate CD. The necessary operations orders and overlays are also provided as separate items. Based on the results of test participants, students required between 18.5 and 19 hours to complete the course, including all tests and the COMPS. The students achieved an overall 90% average for the lesson exams.

All instructional material for the Training Developer course is contained on a single CD. In addition, a loose-leaf notebook contains a course introduction, a course outline, and numerous job aids that are needed as references to review and update existing BSTS courseware. The course is organized into two subjects: how to review and make revisions to text-based lessons in the BSTS courses; and how to review the CBT material in BSTS, then convey the needed changes to a CBT author. There are no COMPS for this course. Test participants completed this course in 5 to 5.5 hours, achieving an overall lesson exam score of 93%.

The CBT Author course is contained on two CDs. It also comes with a loose-leaf notebook with contents similar to the Training Developer course. The course consists of five subjects. Each subject addresses a different portion of the CBT material in the existing BSTS courseware and explains how to make modifications. Test participants completed the course in

19 to 19.5 hours, including all tests. As with the Training Developer course, there are no COMPS. The students achieved an overall average of 85% for the lesson exams.

Feedback from FE participants indicated that all courseware was easy to navigate and the instructional material was clearly presented. They were able to complete the courses without developer assistance. Participants ranked the CBT material, including the tests, as having a higher educational/training value than any paper-based materials.

The 100% CBT Brigade Common Core course trained the same tasks as the text and computer-based Brigade Common Core course in the existing BSTS library. Even though there was no statistical control applied to the group of FE participants for these courses, there is at least one observation worth noting. The existing BSTS course required, on the average, slightly over 31 hours for the participants to complete. This included reading text-based lessons and completing the CBT material (André et al., 1997). The revised course converted all text-based lessons into CBT material. The average time to complete this course was less than 19 hours, nearly a 40% time reduction. A summary of selected data from the FE process is contained in Appendix C.

Lessons Learned

The analysis phase of the SAT process is absolutely critical when producing instructional material. Several key points to emphasize this were encountered in this project. For example, even though the Brigade Common Core course already existed in a combined text and CBT format, it was not sufficient merely to convert text-based lessons into CBT lessons. Two of the doctrinal references had been updated which caused about half of the course content to become outdated. This required a decision as to whether the content of the course should be updated based on the new doctrine. The course content was updated to make it current, but caution must now be used when distributing the library because this course is inconsistent with the other 27 BSTS courses. At some point, the remaining BSTS courses should incorporate the changes based on the new doctrine.

Another key point in the analysis phase is to ensure a complete terminal learning objective (TLO) for the courseware. In the case of the Training Developer course, the initial TLO stated that the student should be able to review BSTS courseware and identify needed changes. After further consideration, it was determined that this person should not only identify needed changes to all courseware, but should also be responsible for actually executing changes to text-based material. This required expanding the course to include techniques and procedures for editing the text material as well as samples of formats used for the various text-based materials.

It is imperative to involve the user early in the design phase of the project. While statements of work and design plans attempt to accurately and completely articulate the expected outcome of a project, ambiguities and misinterpretations will exist. By having early and continual dialogue with the user, variations in interpretations can be identified and brought to a

common understanding. Obtaining approval of course designs early on allows the project resources to be entirely focused on the expected outcome.

Recommendations

As with most research projects, unexpected contingencies typically occur once the actual development begins. In the BSTS II project new techniques to facilitate student learning and retention were incorporated into the courseware. These included ScreenCams™ to teach/show/do and having an authoring program running to allow student practice while the presentation program is running. In some cases this involved using new computer software and also using a combination of software that had not been previously tried. It is difficult to accurately anticipate the problems that might be encountered. Therefore, research program resources should allow for these unexpected challenges.

All required training materials were contained in the student workbook and the accompanying CDs with one major exception. In the case of the Brigade Common Core course, operation orders with overlays were provided, but the actual map sheets were not included. The required maps may not be readily available to all students. Proponents for distributing the courseware should consider including the needed map sheets in the TSP.

The inclusion of an FE phase to review storyboards early in the development process provided an overall resource savings to this project. Identifying content and layout changes on the draft storyboards allowed changes to be implemented before any time and materials were expended to produce graphics or program the courseware. This FE technique was used on other projects (Wampler et al., 1998a, 1998b) to develop CBT, and in every case produced positive results. Future developers should include this FE phase in CBT projects.

The adage that "a picture is worth is thousand words" is certainly true when a student is completing a self-paced course of instruction without instructor interface. Incorporating ScreenCam™ videos throughout the CBT Author course contributed noticeably to learning, according to FE feedback. Videos should certainly be considered as an instructional media in CBT development.

Depending on how a CBT course is structured, it cannot only serve as a training product, but can also be employed as a job/work aid. In the case of the CBT Author course, a person involved in incorporating changes to BSTS courseware could have the CBT Author course running on his computer (using ToolBook II™) and access selected topics for assistance in performing BSTS updates (using IconAuthor™). Future developers should be mindful of this multiple use possibility when designing CBT courseware.

Discussion

The SAT process is a valuable tool when implemented properly. It is important that each of the steps be reviewed and executed. Circumventing or inappropriately abbreviating one of the steps, especially analysis, could cause design and development efforts to expend unnecessary resources and compromise quality of the finished product.

User involvement and FE are essential early in the project and throughout all steps of the SAT process. Especially in research projects, many parameters are not well defined at the outset and decisions that impact design and development occur regularly. With close coordination between the user and developer as well as routine FE phases, informed decisions can be made in a timely manner.

In order to be effective, the BSTS library of courses will require updating and maintaining. Doctrine will continue to change as new equipment is fielded and evolving technologies alter the way the Army fights. This will mandate changes to the courses. With the development of the Training Developer and CBT Author courses, the government now has the capability to train personnel to perform these tasks.

Based on student comments, in both the BSTS II and the BSTS courses, students preferred the CBT material rather than reading text-based material. While statistical comparison between BSTS and BSTS II test results was not attempted in this research effort, there is a need to evaluate the effectiveness of 100% CBT TSPs in an operational (typical user) environment.

Feedback from participants and test results indicate that BSTS II courses are valuable TSPs and enhance the existing library of TSPs developed under the BSTS program. The Training Developer and CBT Author courses should be made available to the agency responsible for updating and maintaining the BSTS courseware.

The 100% Brigade Common Core course, which includes the most current doctrine, should replace the combined text and CBT based course currently being distributed in BSTS. However, there must be a clear explanation included with the courseware that explains the MDMP and military graphics instructional materials contained in this course are based on the versions of FM 101-5 and FM 101-5-1 published in 1997, which is inconsistent with the other BSTS courses. Other courses are still valuable since they address the particular staff officer role in the MDMP process, but the fine points of certain MDMP steps are different. While other BSTS courses are still valuable training materials, they should be updated to reflect the latest doctrine contained in evolving publications, especially the MDMP.

It is clear from student assessments that CBT materials are preferred to reading text-based lessons. In addition, a reduction in course completion time is a distinct advantage. Therefore, a future effort should convert the existing BSTS text-based lessons to CBT.

As expected, courses developed with 100% CBT require more CD space to store the material. The ability to link multiple CDs during the completion of courseware is a necessity and

this process should be transparent to the student. This project used two different linking processes due to the different operating software used to program the courses. When using ToolBook II™, a separate install set was used for each CD. For IconAuthor™, which uses a different operating paradigm, selected files were copied onto both CDs. As additional CBT courseware is developed and different operating systems are utilized, other means to link multiple CDs may be needed. Other technologies and solutions, such as storing courses on a server or on a large capacity hard drive, could alleviate the need for multiple CDs.

The TRADOC has set a course to implement distance learning as a method of instruction now and in the future (DA, 1996). The use of CBT is one of the main distance learning techniques. With the advent of computer technology and the increased access afforded to most military personnel, another means of distributing the CBT courseware besides CD should be pursued. The BSTS courseware could be revised to make it Internet delivered as opposed to CD based.

In addition to revising the BSTS courseware, the TMS should also be adapted to accommodate newer technologies. As currently designed, the TMS operates on a stand-alone computer as well as in a LAN or wide area network. However, the network must be a closed domain for the TMS to function. This limits access to only those personnel within the domain. An open domain TMS that is Internet capable could increase the accessibility to the BSTS courses and facilitate the updating of student results.

While preliminary research results indicate that CBT is an effective instructional media, the value of 100% CBT courses has not been determined. Future research should directly assess the training effectiveness and transfer of 100% CBT material versus a mix of CBT and text-based materials.

The Army Distance Learning Plan (DA, 1996) is moving to take the training to the student rather than bringing the student to the training. In this process, the quality training currently available at Army schools must remain the standard. Increasingly, the benefits afforded by CBT are making this the solution of choice. The BSTS II program accomplished two major objectives that enhance the Army's capability to move more toward CBT. The development of 100% CBT courses breaks the link to required text-based instructional material and the government now has an internal capability to update and maintain the existing BSTS courseware.

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APPENDIX A

Acronyms and Abbreviations

AFRU	Armored Forces Research Unit
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
BSTS	Battle Staff Training System
CAS^3	Combined Arms and Services Staff School
CBT	Computer-Based Training
CD	Compact Disc
COMPS	Comprehensive End of Course Evaluation Component
COR	Contracting Officer's Representative
DA	Department of the Army
FE	Formative Evaluation
FM	Field Manual
FXXITP	Force XXI Training Program
IFRU	Infantry Forces Research Unit
ITTBBST	Innovative Tools and Techniques for Brigade and Below Staff Training
LAN	Local Area Network
MDMP	Military Decision-Making Process
OAC	Officer Advance Course
SAT	Systems Approach to Training
SME	Subject Matter Expert
TLO	Terminal Learning Objective
TMS	Training Management System
TRADOC	U.S. Army Training and Doctrine Command
TSP	Training Support Package

APPENDIX B

BSTS II Formative Evaluation Participant Requirements

The following is a description of the personnel required to conduct FE of the BSTS II courses:

1. Brigade Common Core course

   a. Phase II - Alpha: Must be a combat arms captain or major, who has completed an officer advance course (OAC) and the Combined Arms and Services Staff School (CAS^3). Must have served on the staff of a maneuver brigade for at least a year.

   b. Phase III - Beta: Must be a captain or major of the appropriate branch to fill a Table of Organization and Equipment position of a principal staff officer on a maneuver brigade staff. The officer must have completed the required schools and assignments commensurate with branch and rank to be branch qualified.

2. Training Developer course

   a. Phase II - Alpha: Must be a combat arms captain or major, who has completed an OAC, CAS^3, and the TRADOC training developers course or training developers course for middle managers. Must have 2-3 years experience developing training. A civilian with equivalent experience is acceptable.

   b. Phase III - Beta: Must be a combat arms lieutenant, captain, or major, who has completed an OAC, CAS^3, and the TRADOC training developers course or training developers course for middle managers. A civilian with equivalent experience is acceptable.

3. CBT Author course

   a. Phase II - Alpha: Must have completed the basic and advanced IconAuthor™ course and have six (6) months programming experience; or have three (3) years of programming experience with IconAuthor™; or have similar training/experience in Microsoft Visual C++ or Authorware™. Must be proficient with Windows 3.xx and Windows 95 operating systems. Can be either military (officer or NCO) or civilian.

   b. Phase III - Beta: Must have completed the basic IconAuthor™ course and have two (2) months of programming experience within the previous 12 months. Must be proficient with Windows 3.xx and Windows 95 operating systems. Can be either military (officer or NCO) or civilian.

APPENDIX C

Final Research Report Data

1. Throughout Beta testing, testers recorded the time they spent studying the various course components. The CBT study time was computed based on the average actual time spent by Beta testers studying the CBT material and completing the exams. Based on student experience and proficiency level, the amount of time needed to study doctrine to ensure entry level skills for a course will vary significantly. This chart does not include any time for reading doctrinal material.

STUDY TIME (HOURS)

COURSE	HOURS
Common Core	18.64
Training Developer	5.34
CBT Author	19.42
TOTAL	43.40

2. The following chart shows the number of lessons contained in the BSTS II courses.

NUMBER OF LESSONS

COURSE	# Lessons
Common Core	12
Training Developer	4
CBT Author	14
TOTAL	30

3. Each of the subjects within each of the courses contains a pretest which the student must complete in order to receive credit for the course within the training management system and be allowed to take the lesson exams. A post test is provided at the end of each subject. Scores in the below chart were computed by averaging all subject test scores, for all Beta testers, for all Subjects within the designated course. The "improvement" is the difference between the pretest and post test scores.

PRETEST/POST TEST IMPROVEMENT (%)

COURSE	PRETEST	POST TEST	IMPROVEMENT
Common Core	82	94	12
Training Developer	63	92	29
CBT Author	N/A	89	N/A
AVERAGE	73	92	19

(N/A = Not applicable)

4. Every lesson in every subject of every course contains a lesson exam that is CBT-based. Scores in this chart were computed by averaging all lesson exam scores, for all Beta testers, for all lessons within the designated course.

LESSON EXAM SCORES

COURSE	EXAM SCORES
Common Core	90
Training Developer	93
CBT Author	85
AVERAGE	**89**

5. A CBT-based, comprehensive exam is provided at the end of the Brigade Common Core course. The average comprehensive exam score for all Beta testers within the course was 82%.

6. At the completion of each Subject for each course, the students were asked to rank order the course components as to their educational/training value. The columns in the chart below represent the course components:

-Workbook: Student Workbook introduction.

-Job Aids: Checklists and guides contained in the back of the Student Workbook, that can be reproduced and used by staff officers to assist them in the performance of their duties.

-References: Doctrinal publications used as references for each of the lessons.

-CBT: Computer-based training material (lessons, tutorials and practical exercises).

-Exercises: Subject, lesson, and COMPS exams.

The numbers in this chart were computed by averaging the ratings based on the assessment by all Beta testers within the designated course. In this chart "1" means the most valuable and "5" means the least valuable.

STUDENT RANKINGS OF COURSE COMPONENTS

COURSE	WORKBOOK	JOB AIDS	REFERENCE	CBT	EXERCISE
Common Core	4	3	5	1	2
Training Developer	4	3	5	1	2
CBT Author	3	4	5	1	2